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THE MESENTERIES OF THE SAURIA.¹

BY E. D. COPE.

Examination of the literature shows that this subject has been nowhere adequately treated. The most considerable paper is one by Dr. F. E. Beddard in the Proceedings of the Zoological Society of London for 1888. This, however, includes an examination of a limited number of genera, (eight) only. The present paper is founded on a study of most of the genera of all the families, excepting in the cases of the Geconidæ and Agamidæ, where my opportunities have been more restricted. I am indebted for this material to the U. S. National Museum, the collections of the Academy of Natural Sciences of Philadelphia and my own.

A fold suspends the alimentary canal from the median dorsal line, forming the dorsal or epigastric mesentery (E G). No other mesenteries bind the alimentary canal, except the stomach, and sometimes the adjacent portion of the small intestine, which have other connections. The liver, on the other hand, has several mesenteric connections, as follows: Its ventral face has usually a single sheet connecting it with the median ventral line, but in rare instances it is bifurcate posteriorly (Scincidæ generally), or even double (*Tiliqua*, LHV, RHV). This sheet, or one of them, is continued along to the anterior abdominal artery to the ventral wall, and sometimes along the gall-duct to the pyloric part of the small intestine. Each border of the liver is twice or thrice concave above, in adaptation to the stomach and lungs in the types where the latter extend so far posteriorly, which is the usual arrangement. From the left hand ridge thus produced, a sheet or mesentery extends to the stomach, forming the gastrohepatic mesentery (GH). It is sometimes median in position. From right hand superior angle a mesentery extends to the right dorsal body wall, forming the right hepatic mesentery. The four mesenteries now described are the only ones which are universally present, which bind the liver. The following sheets are present in various types. Frequently the right hepatic and the gastrohepatic give off sheets to the right

¹ Read before the American Association for the Advancement of Science, Springfield meeting, Aug. 30th, 1895.

and left lungs respectively, constituting the right hepatopulmonary and gastropulmonary mesenteries (RHP. and GP.). A sheet occasionally goes off from the gastrohepatic to the left body wall, forming the left gastroparietal mesentery. This is frequently represented by a narrow band, and occasionally, as in *Dipsosaurus*, it joins the small intestine just beyond the extremity of the gastrohepatic sheet. This is not represented on the accompanying diagram. In *Heloderma* a distinct sheet extends from each border of the liver to the body walls, forming the right and left lateral hepatic mesenteries (LLH, RLH). In *Chamæleon*, *Polychrus* and *Anolis*, the left lung besides being attached to the gastrohepatic mesentery, is attached by a sheet to the left border of the liver, forming the left hepatopulmonary mesentery, (LHP).

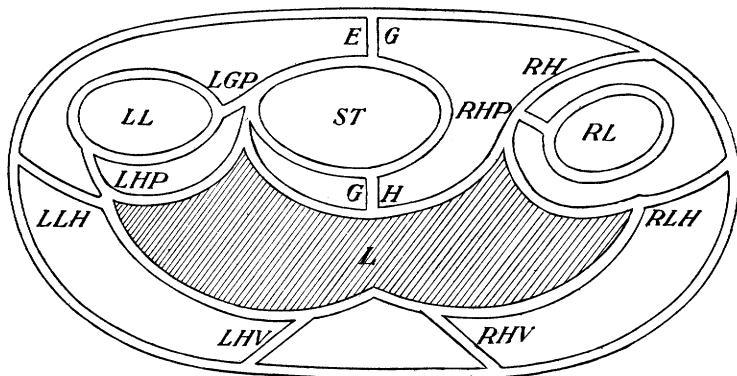


Diagram of peritoneum of Sauria, with all the folds displayed by a transverse section near the middle of the liver. L liver; St. stomach; RL right lung; LL left lung; EG epigastric peritoneal fold; LHV and RHV, left and right hepatovenous folds; RLH and LLH, right and left lateral hepatic folds; RH, right hepatic; GH, gastrohepatic; LHP and RHP left and right hepatopulmonary folds.

In *Varanus salvator* there is a short median gastrohepatic sheet (GH). In *Varanus*, owing to the anterior position of the lungs, they have no hepatic or gastric connections. In no Saurian have I observed a right hepatopulmonary sheet, as the right hepatic mesentery supports the right lung. The latter extends along the apical strip of the right lobe of the liver to the genital mesentery in many genera. In *Tupinambis*, *Dracæna*, and some others, the right hepatic extends as a strong sheet to the right body wall, forming with an equally strong gastroparietal of the left side, a kind of dia-

phragm. In many genera, the right hepatic sheet is connected with the stomach, especially at its proximal part.

Besides the hepatic and gastric mesenteries, there are those which enclose the internal genitalia, the urinary bladder, and the corpora adiposa. The genital mesentery is sometimes quite extensively free, and is always so anteriorly, especially where it supports the wide fontanelle of the oviduct. A mesenteric pouch encloses the corpora adiposa, only in those forms where those bodies project freely into the abdominal cavity, as is frequently the case. The cystic mesentery is a transverse fold of the peritoneum which lines the inferior wall of the pelvic cavity, which encloses the urinary bladder, when it is present.

Beddard has stated that in the genus *Varanus* there is a "horizontal sheet" of mesentery between the viscera and the abdominal peritoneum. This is an interpretation of the fact that the abdominal peritoneum is loosely attached to the abdominal muscular sheaths, and is readily separated from them. This sheet, however, presents the usual relation of the abdominal peritoneum to the viscera, as Beddard states, and appears to me to be homologous with it.² The same condition caused Günther³ to state that in *Regenia ocellata* the corpora adiposa are enclosed in "a separate sac of the peritoneum," whereas the former are not enclosed in a special sac as in some other genera.

In the Chamæleonidæ the mesenteries include the usual hepatoven-tral, epigastric, gastrohepatic and right hepatic, the last including the right lung. The left lung is included in a left hepatogastric, a feature seen in few other groups, notably in the Anoline Iguanidæ. There is also a left hepatolateral, from the liver to the left body wall, having a direction diagonal to the long axis of the liver in *C. basiliscus*.

In the Nyctisauræ I have been able to examine the mesenteries in relatively few genera of the superfamily. I find in both Geconidæ and Eublepharidæ the structure to be of the type most frequent in the Sauria; *i. e.*; a simple hepatoven-tral; a single gastrohepatic; a left gastropulmonary; and a right hepatic which embraces the right lung.

In the Agamidæ the mesenteries present the usual sheets, hepatoven-tral, gastrohepatic, left gastropulmonary and right hepatic,

² Proc. Zool. Soc., London, 1888, p. 98.

³ Loc. cit., 1861, March.

which includes the right lung. I have noted the following modifications: In *Agama colonorum* the left gastropulmonary has become a right gastrohepatic by its continuing to the liver, a character observed in *Chamæleon* and the *Anolinæ*. There is also in this species a left hepatomarginal. In *Megalochilus auritus* there is a right hepatovernal, as in *Phrynosoma*.

In the *Iguanidæ* the hepatic mesenteries conform to the general type, with certain exceptions to be mentioned. Thus there are no right or left lateral hepatic mesenteries, and but one ventral. The right hepatic supports the right lung. There is frequently a rudimental right lateral hepatic which connects the long right apex of the liver with the right body wall. There is a gastrohepatic which generally spreads over the space enclosed in the bend of the stomach. There is no left gastroparietal sheet or band. The most remarkable deviation from this type (which I have verified in twenty genera) is found in the *Anolinæ*. Here the left lung, besides its superolateral connection with the stomach, is connected by a special sheet with the left part of the inferior face of the liver. Thus the latter organ is suspended by two sheets to the left side of the middle line. In genera where this is the case the two sheets are sometimes difficult to distinguish owing to their easy adhesion together. They may be separated by inserting a probe from the free caudad extremity of the lung.

Another variation from the normal type is seen in the presence of a right lateral hepatic sheet in *Phrynosoma* and *Polychrus* (in *Polychrus gutturosus* it is wanting in the one specimen examined). A left lateral sheet is present on the cephalad half of the liver in *Cyclura cornuta* and *Polychrus marmoratus*. It is rudimental in *Polychrus acutirostris*, and wanting in *P. gutturosus*. There is a gastroparietal band in *Cyclura cornuta*, which is joined by the apex of the peritoneum of the corpus adiposum.

In the *Anguidæ* the viscera do not display any exceptional features, except as to the serpentiform genera. The mesenteries are of the typical character, modified in *Ophisaurus* by the reduction of the left lung. The hepatovernal sheet is very near the left margin of the liver in *Pseudopus apus*, and the gastrohepatic and right hepatic are near together when slack.

In the *Helodermatidæ* the mesenteries of *Heloderma* are characteristic. There is a single hepatovernal, and the gastrohepatic has the usual position. The right hepatic goes to the right side of the

stomach, becoming a right gastrohepatic, and does not extend to the dorsal peritoneum, a character in which it is unique in the Sauria. Posterior to the middle of the liver they unite on the middle line, as in the Teidæ. The lungs are attached to the adjacent parts of the gastric peritoneum by separate sheets, the right and left gastropulmonary. Besides these there is a strong sheet on each side extending from the superior side of the liver near the border, to the body wall, forming the right and left hepatolateral. The right hepatolateral does not extend along the right border of the liver beyond the cephalad half. The right gastrohepatic continues along the elongate right process of the liver to the genital fold of the peritoneum, and the apex of this process of the liver sends a recurrent sheet backward, which forms with the former, a funnel-shaped passage. This recurrent sheet might be regarded as a caudad hepatolateral. Dr. Shufeldt states⁴ that *Heloderma* possesses the free ventral peritoneum found in *Varanus*, but this is not the case, as this structure is the usual one.

The peritoneum forms a transverse fold at the posterior part of the corpora adiposa, supporting the urinary bladder, and forming the cystic mesentery. It is but loosely attached to the corpora adiposa, which do not project freely from the body wall and hence have no special peritoneal pouch. They are elongate and coarsely subdivided.

In the Zonuridæ the mesenteries in the genus *Zonurus* are of the usual type. There are one hepatoventral, a gastrohepatic, a left gastropulmonary, and a right hepatic which encloses the right lung.

The mesenteric attachments of the liver are very characteristic in the Teidæ. There is but one suspensor, a median gastrohepatic, but this bifurcates above the middle of the organ, and each half diverges, and adhering to the caudad margin, extends to the lateral inferior body wall on each side. In *Tupinambis* these sheets are united on the median line for a distance posterior to the liver. The lungs are each attached to the stomach by a separate sheet. The left hepatoparietal sheet is always present in this family, but the right one is feeble in some genera, and is easily ruptured, as for instance in *Cnemidophorus*. I have examined the genera *Dracæna*, *Tupinambis*, *Callopistes*, *Amiva*, *Cnemidophorus*, *Centropyx*, *Tejus*, *Anadia* and *Oreosaurus*.

⁴Proceeds. Zool. Soc., London, 1890, pp. 193-4.

In the Scincidæ, as in other families, in the serpentiform types the liver and stomach occupy a position caudad to the lungs, and so the latter do not appear in the mesenteric connections of the former, *e. g.* *Siaphus*. The mesenteries are the usual ones, but one peculiarity is very frequent though not universal in the family. The hepatoven-tral sheet is generally divided into two, a right and left sheet next the liver, forming a pocket which opens caudad. In the *Tiliqua scincoides* the two sheets only unite at the cephalic end of the liver, remaining separate throughout.

In the Anniellidæ the viscera display the following characters. The left lung is much smaller than the right lung and is proximally fused with it, so that there is but a single lumen. Right lung much enlarged and covering the alimentary canal below (ventrad). Liver considerably posterior to heart, long and narrow, with a small left lobe and a long right lobe extending to the reproductive cells. Gall bladder enclosed by the liver and exposed inferiorly, *i. e.*, occupying a foramen as in the Diploglossa. Alimentary canal distinguished into stomach, and a small and large intestine, without distinct colon. Stomach without curvature; small intestine moderately plicated, with lacertiform mesentery. Reproductive cells anterior, symmetrical; kidneys symmetrical, posterior. There is a single gastro-hepatic mesentery from the middle line of the liver, and no right hepatic or lateral hepatics. Hepatoven-tral simple; plates of epigastric very loosely attached together. No pulmonaries at middle of liver.

The fusion of the lungs is a peculiarity that I have not noticed elsewhere among the Sauria. The left lung is like a diverticulum of the right, and posterior to the point of divergence from the latter is bound to it by connective tissue to the extremity. This fusion is a step nearer to obliteration than occurs in any of the serpentiform genera of Teidæ, Scincidæ or Anguidæ, where, though of reduced size, it is distinct from the right except at its proximal extremity.

In the Amphibænidæ, as the left lung only is present in this family, there is but one gastropulmonary mesentery. The liver has a crescentic cross-section, and it is supported by two gastrohepatic mesenteries (*Amphibæna alba* and *A. fuliginosa*), or by only one, and a right hepatic or hepatolateral, as it may be: (*Rhineüra floridana*). There is but one hepatoven-tral. The last described structure also characterizes *Euchirotres diporus*.

Since the above was written a paper has been published in the Proceedings of the Zoological Society of London (1895, p. 702) by Mr. G. W. Butler on the lungs of snakes, *Amphisbænida*, etc. Here the fact of the suppression of the right lung in the *Amphisbænia* is pointed out.